Teaching at the interface between analytical chemistry and biology offers the opportunity to address many of the complexities inherent in modern analytical chemistry while applying them to interesting biochemical or biomedical topics. Because many undergraduate students are interested in careers in molecular biology, biochemistry, or medicine, teaching analytical chemistry from a biological point of view helps to capture student interest and can make the course feel more relevant while equipping future biologists and medical professionals with a solid intellectual foundation that will better enable them to understand the science involved in making and interpreting chemical measurements.

At the undergraduate level, bioanalysis can be introduced into traditional analytical chemistry courses by judicious use of biochemically relevant examples. Some texts, such as “Analytical Chemistry” (John Wiley & Sons) by Gary D. Christian, feature material to augment more traditional analytical topics, including kinetic methods of analysis, clinical chemistry, and genomics and proteomics. In addition, two new texts specifically addressing bioanalytical chemistry have recently been published. “Bioanalytical Chemistry” (Imperial College Press) by Andreas Manz, Nicole Pamme, and Dimiti Iossifidis is at a level appropriate for undergraduate instruction and includes an introduction to biomolecules followed by chapters discussing separation methods, mass spectrometry, biosensors, DNA arrays, sequencing and amplification of nucleic acids, and protein sequencing. Another book, also entitled “Bioanalytical Chemistry” (Wiley–Interscience) by Susan Mikkelsen and Eduardo Cortón, covers the subject in greater depth and might be more appropriate for a graduate course. In addition to the topics addressed by Manz et al., the book by Mikkelsen and Cortón discusses quantitative spectroscopic assays for determining total protein, DNA, RNA, and carbohydrate content, enzymes and methods for quantitation in enzymatic assays, immobilized enzymes, antibodies and quantitative immunoassays, analyses based on centrifugation methods, and validation of new bioanalytical methods. If the undergraduate curriculum and/or student interest permit, a specific bioanalytical course may be offered. For example, at St Olaf College, Northfield, MN, USA, Professor Doug Beussman teaches an intensive bioanalytical chemistry undergraduate course during their four-week January inter-term using the text by Mikkelsen and Cortón supplemented with instructor-provided handouts.

Many universities also offer graduate courses in bioanalytical chemistry, either as core (required) courses or as special topic courses. What is taught varies with the local interests and areas of specific expertise. Graduate courses are also more likely to forgo use of a text and rely on the primary research literature as a supplement for material covered in lecture. In thinking about what to cover in my own bioanalytical chemistry course I felt that it was important that the course material could be clearly distinguished from a course in biophysical measurements. In my opinion a biophysical methods course would have a primary emphasis on protein secondary and tertiary structure using measurement methods like circular dichroism, multidimensional NMR, fluorescence, and X-ray spectroscopy that are used to provide information about structure and dynamics but not for quantitative analysis. The other issue that I considered is whether bioanalytical chemistry and analytical biochemistry were one an the same. To address this issue I settled on a definition of bioanalytical chemistry as “the development and application of chemical measurements and instrumentation to problems in biology, biochemistry, and medical science”. In designing my course, I thought it also necessary to take into account that at many pharmaceutical companies, important consumers of our graduate and undergraduate students, bioanalytical chemistry is synonymous with measurements in biological samples, typically in support of investigations of drug metabolism and pharmacokinetics. Therefore in
my ten-week graduate course, I started with an introduction to the drug discovery process followed by discussion of pharmacokinetics and metabolite identification. The remainder of the course focused on the analytical chemistry of genomics, proteomics, metabolomics, and immunoassays. Because our graduate students also take technique specific courses in separations, mass spectrometry, electrochemistry, and optical spectroscopy, I tried to avoid topics such as biosensors and surface plasmon resonance that are taught in depth in other courses. Like most survey courses, one of the limitations of this course is that specific topics cannot be addressed in depth. However, for the target audience of entering graduate students, having an overview of bioanalytical chemistry provides the advantage of having a context for learning techniques and a useful backdrop for choosing their dissertation research.

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